The ***Sugeno Fuzzy model*** (also known as the ***TSK fuzzy model***) was proposed by Takagi, Sugeno, and Kang in an effort to develop a systematic approach to generating fuzzy rules from a given input-output dataset. A typical fuzzy rule in a Sugeno fuzzy model has the form:

$$if\ x\ is\ A\ and\ y\ is\ B\ then\ z = f(x,y)$$

where A and B are fuzzy sets in the antecedent, while z=f(x,y) is a crisp function in the consequent.

Usually f(x, y) is a polynomial in the input variables x and y, but it can be any function as long as it can appropriately describe the output of the model within the fuzzy region specified by the antecedent of the rule.

When f(x, y) is a first-order polynomial, the resulting fuzzy inference system is called a first-order Sugeno fuzzy model, which was originally proposed in [1, 2].

When *f* is a constant, we then have a ***zero-order Sugeno fuzzy model,*** which can be viewed either as a special case of the Mamdani Fuzzy inference system, in which each rule's consequent is specified by a fuzzy singleton (or a pre-defuzzified consequent), or a special case of the Tsukamoto fuzzy model, in which each rule's consequent is specified by an MF of a step function centre at the constant. Moreover, a zero-order Sugeno fuzzy model is functionally equivalent to a radial basis function network under certain minor constraints, as discussed in Chapter 12 in "Neuro-fuzzy and soft computing".

The output of a zero-order Sugeno model is a smooth function of its input variables as long as the neighbouring MFs in the antecedent have enough overlap. In other words, the overlap of MFs in the consequent of a Mamdani model does not have a decisive effect on the smoothness; it is the overlap of the antecedent MFs that determines the smoothness of the resulting input-output behaviour.

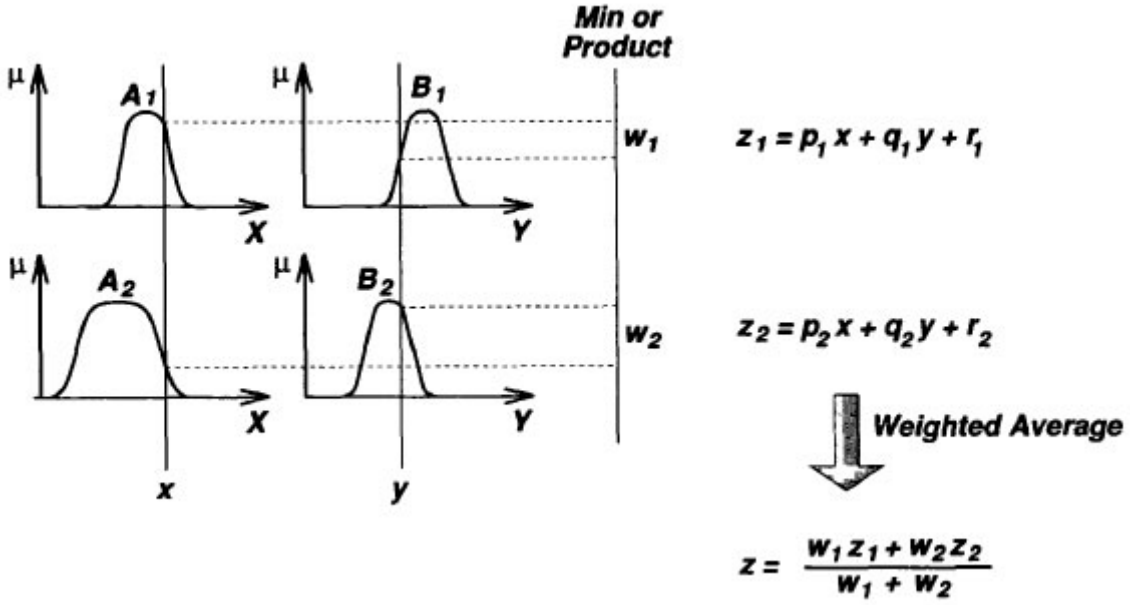

Figure 1: 1st order Sugeno Fuzzy Model